

REMARKS

Applicants appreciate the thorough review of the present application as evidenced by the Official Action. Claims 1-4 have been canceled and the remaining independent claims, namely, independent Claims 5 and 14, have each been amended to further patentably distinguish the cited references, as described in more detail below. Additionally, the title has been amended to more clearly indicate the invention to which the claims are directed. As such, Applicants submit that the objection to the title has been overcome. The objection to the Declaration is also noted. The inventors are in the process of again executing the Declaration and the newly executed Declaration will be submitted under separate cover once each inventor has signed in order to address this objection. In view of the amended claims and the following remarks, Applicants respectfully request reconsideration and allowance of the claims of the present application.

The Invention

A string switching apparatus and method is set forth by amended independent Claims 5 and 14 for controllably connecting a plurality of solar array strings to either an output power bus or an auxiliary power bus, such as a battery charging power bus. By permitting the solar array strings to not only provide power to the output power bus, but also to deliver power to other power buses, the power provided by the solar array can be more efficiently utilized and less power needs to be shunted or otherwise dissipated.

As recited by amended independent Claim 5, the string switching apparatus includes a plurality of shunt regulators, electrically connected in parallel with respective solar array strings. Each shunt regulator is capable of shunting the output of the respective solar array string. However, each shunt-type regulator is also capable of permitting the output of the respective solar array string to be delivered to one of the output power bus and the auxiliary power bus. The string switching apparatus of this embodiment also includes a plurality of coupling switches electrically connected between respective solar array strings and one of the output power bus and the auxiliary power bus. Typically, the plurality of coupling switches are electrically connected

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between a respective solar array string and the auxiliary power bus. Each coupling switch is capable of switching between an on state in which the entire, unshunted output of the respective solar array string is delivered to the respective power bus, and an off state in which the entire, unshunted output of the respective solar array string is delivered to the other power bus.

Accordingly, the entire, unshunted output of the respective solar array string is directed to only one power bus at a time. As such, the string switching apparatus and method of this embodiment provides for the controlled delivery of power to both the output power bus and the auxiliary power bus.

As recited by amended independent Claim 14, the output of each solar array string is selectively directed to the output power bus, the auxiliary power bus or a shunt path such that the output power bus and the auxiliary power bus are maintained at respective predetermined power levels. In this regard, the shunt regulator is actuated in instances in which the output of the respective solar array string is to be directed to the shunt path. In contrast, the shunt regulator is deactuated in instances in which the output of the respective solar array string is to be directed to either the output power bus or the auxiliary power bus. In instances in which the respective solar array string is not shunted, the entire output of the solar array string can be switchably connected to either one of the output power bus and the auxiliary power bus. Thus, the entire, unshunted output of the respective solar array string is directed to only one power bus at a time. Thus, the string switching apparatus and method of the claimed invention can even more efficiently utilize the power provided by a solar array by not requiring as much power to be shunted.

The Claims are Patentable.

The Official Action rejects Claims 1-19 under 35 U.S.C. § 102(b) as being anticipated either by U.S. Patent No. 5,814,903 to Keng Wu or by U.S. Patent No. 3,696,286 to Louis Ule. Claims 1-4 have been cancelled. In addition, each of the remaining independent claims, namely, independent apparatus Claim 5 and independent method Claim 14, have been amended to further patentably distinguish the claimed invention from the cited references, as described in detail below.

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The Wu '903 patent describes a control system for selectively shunting one or more solar panels in order to maintain a constant load voltage. With respect to the claims that remain in the present application, however, it is notable that the control system described by the Wu '903 patent provides for the output of each solar panel to be either provided to the load or shunted to ground, and does not teach or suggest applying the output to any other power bus or load.

As described above, the string switching apparatus as recited in amended independent Claim 5 includes a plurality of shunt regulators that are capable of alternately shunting the output of respective solar array strings or delivering the output of respective solar array strings to one of an output power bus and an auxiliary power bus. Additionally, the string switching apparatus of amended independent Claim 5 includes a plurality of coupling switches for switching between an on state in which the entire, unshunted output of respective solar array strings is delivered to one of the buses and an off state in which the entire, unshunted output of a respective solar array string is directed to the other power bus. Thus, for each solar array string, the string switching apparatus of amended independent Claim 5 can shunt its entire output, can deliver its entire output to the output power bus, or can deliver its entire output to the auxiliary power bus.

In contrast, the Wu '903 patent does not teach or suggest a string switch apparatus for controllably connecting the output of a solar array string to two different power buses, but instead directs any unshunted output to a single output bus. More particularly, the Wu '903 patent does not teach or suggest a plurality of coupling switches for alternately connecting the entire, unshunted output of respective solar array strings to one of the output power bus and to the auxiliary power bus, as recited by amended independent Claim 5. Instead, the Wu '903 patent contemplates that the output of each solar array string will either be shunted to ground or provided to the output power bus. As such, the Wu '903 patent does not teach or suggest this string switching apparatus of amended independent Claim 5. As such the rejection of amended independent Claim 5, as well as the claims that depend therefrom, for being anticipated by the Wu '903 patent is therefore overcome.

Similar to the string switching apparatus of amended independent Claim 5, the method of amended independent Claim 14 selectively directs the entire output of each solar array string to

one of the output power bus, the auxiliary power bus or a shunt path in order to maintain both the output power bus and the auxiliary power bus at respective predetermined power levels. In order to selectively direct the output of each solar array string as desired, the method of amended independent Claim 14 actuates a shunt regulator in instances in which the output of a respective solar array string is to be shunted, and deactuates the shunt regulator in instances in which the output of the respective solar array string is to be directed to one of the power buses.

Additionally, in instances in which the output of a respective solar array string is not shunted, the method of amended independent Claim 14 switchably connects the entire output of the respective solar array string, i.e., the entire, unshunted output, to one of the output power bus and the auxiliary power bus. Generally depending upon the power levels of the different power buses, the entire, unshunted output of a solar array string may be switched from one power bus to the other power bus, and back again. As such, the method of amended independent Claim 14 also provides for the entire output of each solar array string to be shunted to ground or to be directed either to an output power bus or to an auxiliary power bus such that each power bus is maintained at a respective predetermined power level.

As described above in conjunction with the string switching apparatus of amended independent Claim 5, the Wu '903 patent does not teach or suggest any technique for providing the output of a solar array string to any power bus other than a single, generic output bus. Thus, the Wu '903 patent does not teach or suggest selectively directing the entire output of each solar array string to one of an output power bus, an auxiliary power bus or a shunt path. More particularly, the Wu '903 patent does not teach or suggest switchably connecting the output of a respective solar array string to one of the output power bus and the auxiliary power bus as recited by amended independent Claim 14. As such, Applicants submit that the Wu '903 patent does not teach or suggest the method of amended independent Claim 5. Accordingly, the rejection of amended independent Claim 14, as well as the claims that depend therefrom, for being anticipated by the Wu '903 patent is therefore overcome.

In contrast to the Wu '903 patent, the Ule '286 patent does not describe shunting the output of a solar cell array to ground. Instead, the Ule '286 patent describes a string switching

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apparatus that is designed to reduce fluctuations in the output voltage provided by a solar cell array. In particular, the output of the solar cell array is compared to a reference voltage. In instances in which the output of the solar cell array exceeds the reference voltage, a greater percentage of the output of the solar cell array is diverted to a storage battery in order to reduce the power delivered to the load. In contrast, if the output of the solar cell array is less than the reference voltage, a smaller percentage of the output of the solar cell array is diverted to the storage battery and a greater percentage of the output of the solar cell array is delivered to the load. Moreover, the Ule system includes a solenoid or the like for connecting the storage battery to the load in instances in which the output of the solar cell array is too small. See, for example, col. 2, lines 1-31 and col. 4, lines 18-38 of the Ule '286 patent.

As described above, the string switching apparatus of amended independent Claim 5 includes a plurality of coupling switches that are each capable of switching between an on state in which the entire, unshunted output of the respective solar array string is delivered to one power bus and an off state in which the entire, unshunted output of the solar array string is directed to another power bus. As such, the plurality of coupling switches provide for the entire, unshunted output of a respective solar array string to be directed to only one of the power buses at a time, but permit the entire, unshunted output to be later switched to the other power bus, if so desired. Likewise, the method of amended independent Claim 14 switchably connects the entire, unshunted output of a respective solar array string to one of the output power bus and the auxiliary power bus in instances in which the power is to be delivered to the respective power bus, and switchably disconnects the entire, unshunted output of the respective solar array string from the respective power bus in instances in which the power is to be delivered to the other power bus. As such, the method of amended independent Claim 14 also provides that the entire, unshunted output of a respective solar array string be directed to only one power bus at a time.

In contrast, the Ule '286 patent describes a system in which a variable portion of the output of each solar array cell is diverted to a storage battery. As such, the Ule '286 patent describes a system that divides the output of each solar array cell between a storage battery and a load, and does not provide the entire output to either the storage battery or the load. The Ule '286

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patent therefore neither teaches or suggests a string switching apparatus nor an associated method in which the entire output of a respective solar array string can be shunted, delivered to the output power bus or delivered to the auxiliary power bus. In other words, the Ule '286 patent neither teaches or suggests a string switching apparatus nor an associated method in which the entire, unshunted output of a respective solar array string is directed to only one of the power buses at a time as recited by amended independent Claims 5 and 14, but, instead, divides the output between a pair of loads. Additionally, the Ule '286 patent does not teach or suggest alternately shunting an output of a solar array sting to ground, such as by means of shunt regulators, as also recited in each of amended independent Claims 5 and 14. For at least each of the foregoing reasons, Applicants submit that amended independent Claims 5 and 14, as well as the claims that depend therefrom, are patentably distinct from the Ule '286 patent and that the rejection of these claims under 35 U.S.C. § 102(b) for being anticipated by the Ule '286 patent is therefore overcome.

Although the claims are currently rejected as being anticipated under 35 U.S.C. § 102(b) by either the Wu '903 patent or the Ule '286 patent, it is noted that the apparatus and method of amended independent Claims 5 and 14 are also not taught or suggested by the combination of these references. In this regard, even if an argument were made that the references could somehow be combined, the combination would still fail to teach or suggest an apparatus and method that are capable of switching the entire, unshunted output of a solar array string between two power buses, such as an output power bus and an auxiliary power bus, such that the entire, unshunted output of the respective solar array string is directed to only one power bus at a time, as recited by amended independent Claims 5 and 14. Accordingly, Applicants submit that amended independent Claims 5 and 14, as well as the claims that depend therefrom, are also patentably distinct from any purported combination of the cited references.

CONCLUSION

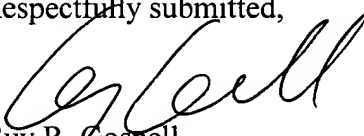
In view of the amended title, the amended claims and the remarks presented above, it is respectfully submitted that the present claims are in condition for immediate allowance. It is

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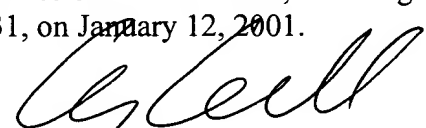
therefore respectfully requested that a Notice of Allowance be issued. The Examiner is encouraged to contact Applicants' undersigned attorney to resolve any remaining issues in order to expedite the examination of the present application.

It is not believed that extensions of time or fees for net addition of claims are required, beyond those that may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 CFR § 1.136(a), and any fee required therefore (including fees for net addition of claims) is hereby authorized to be charged to Deposit Account No. 16-0605.

Respectfully submitted,


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